SNAPA

The Swift Neurological Acceleration of Atmospheric Photochemistry and Aerosol Calculations

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Sister proposal with Max Suarez (GSFC/GMAO)

GMI January 2006

Concept

- To accelerate key parts of the GMI model with adaptive error monitoring using neural networks
  - Year 1: ODE Solver
  - Year 2: Photolysis
  - Year 3: Aerosols

Achieved so far!

- Pilot study with 200 x speed up for ODEs (once the training is complete).
- New release of Fortran90 neural network software.
- Involved 1 month visit of Hamse Mussa from Cambridge University during November.

Achieved so far!

- New version of code performing very well. Written so it can easily be used by others.
- As test cases we have already applied new version of NN code to:
  - Tracer correlations
  - NDVI mapping AVHRR->MODIS.

Achieved so far!

- NDVI mapping will hopefully have a future use for real time estimation of biogenic emissions.
- Jules Kouatchou and Tom Clune have provided sample training data set. Latest version received last week.

Some Examples of the use of NN

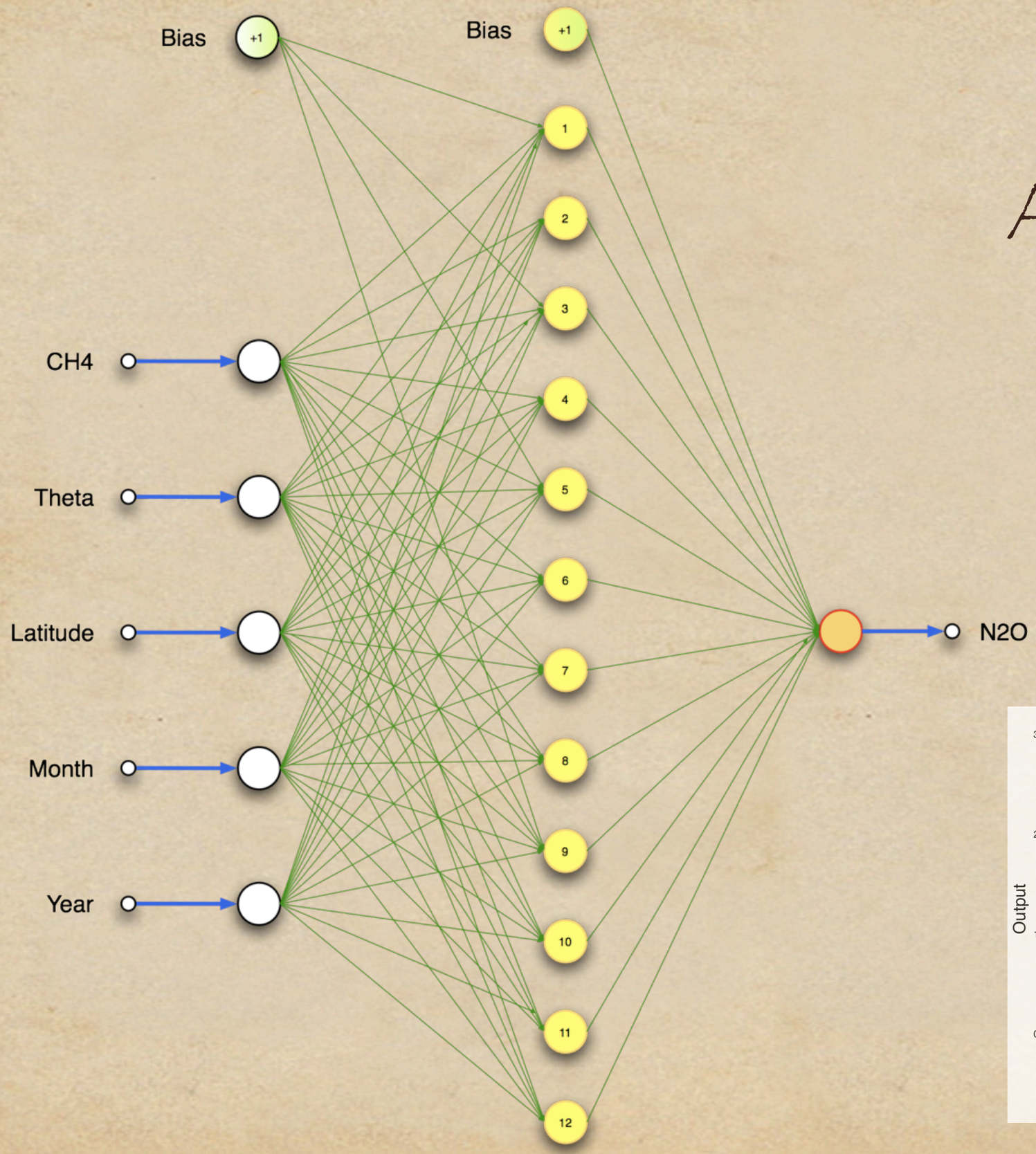
Other GSFC Applications

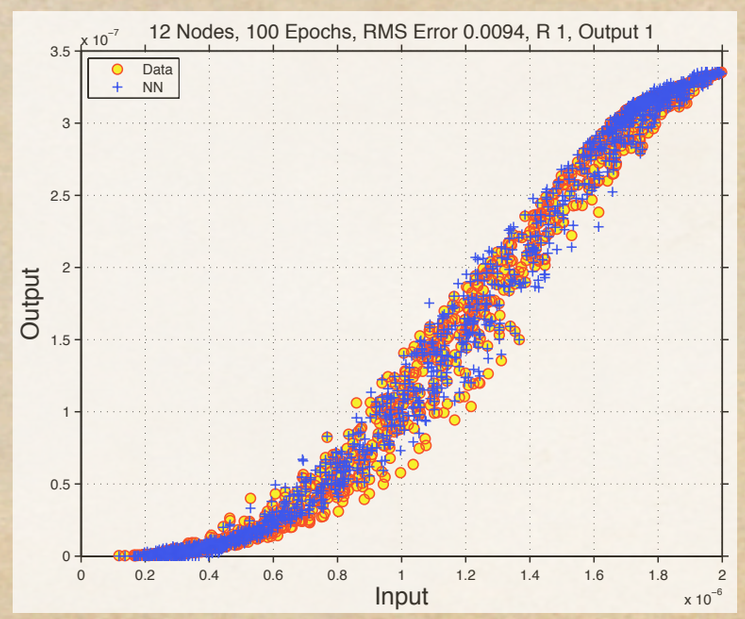
- Learning chaotically tumbling orbit of the Hubble Space Telescope
- Heating rate calculations with GMAO
- Tracer correlations
- NDVI mapping
- Fire prediction with US Forestry Service
- Lightning parameterization
- Earth quake prediction

Tracer correlations

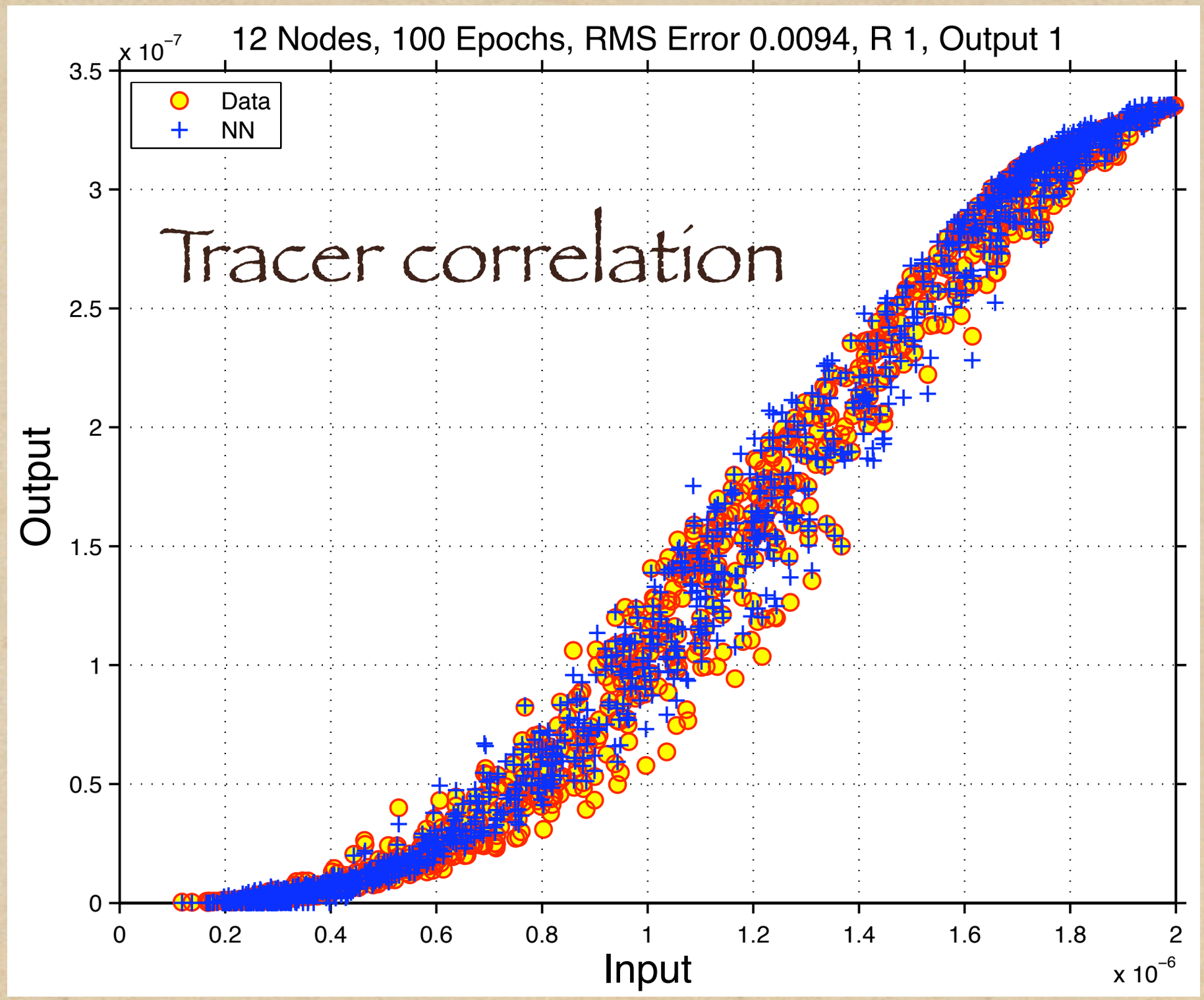
- 5 inputs: CH4, latitude, potential temperature, year, month.
- 1 output: N2O.
- 12 hidden nodes.

Network Architecture

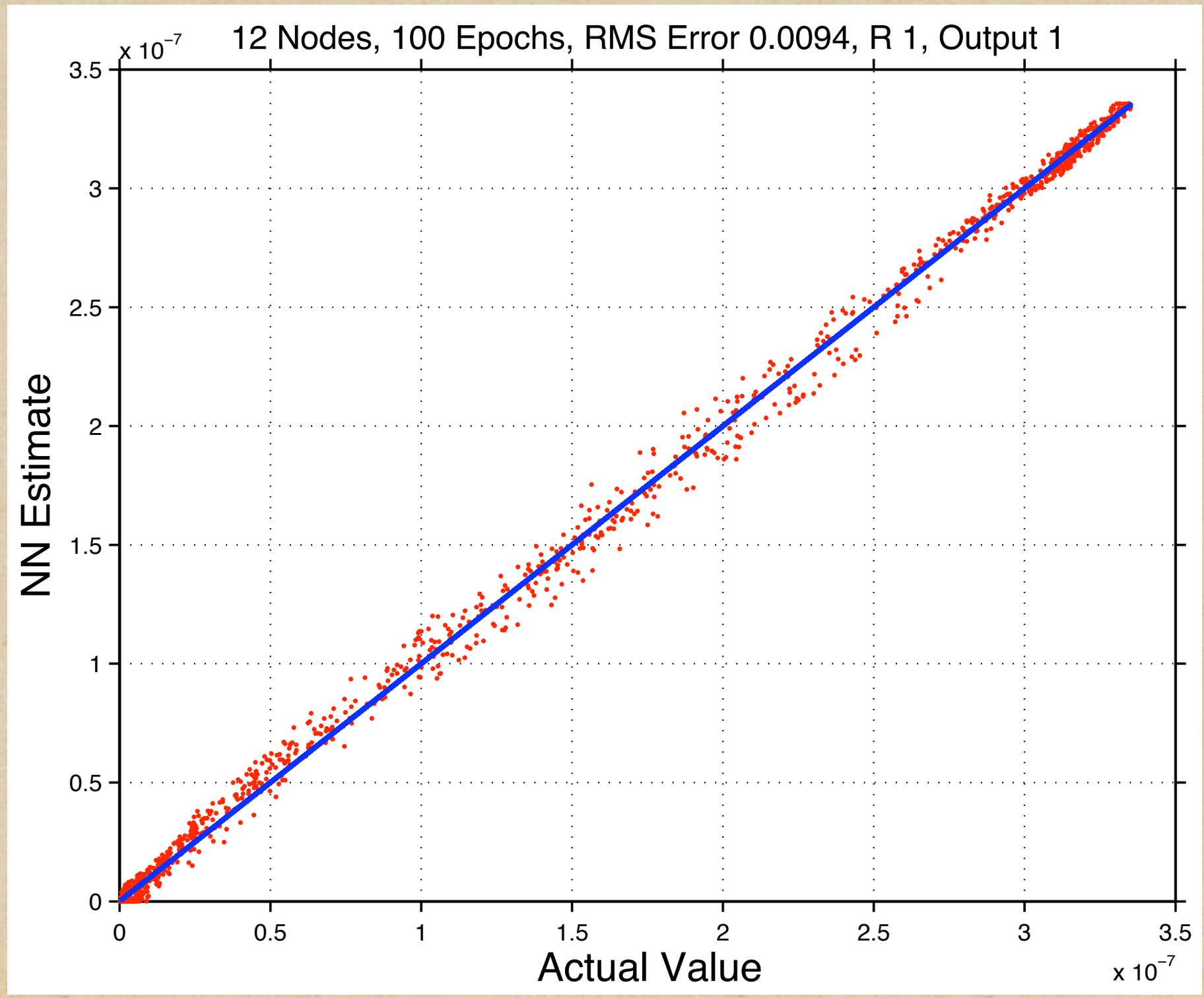


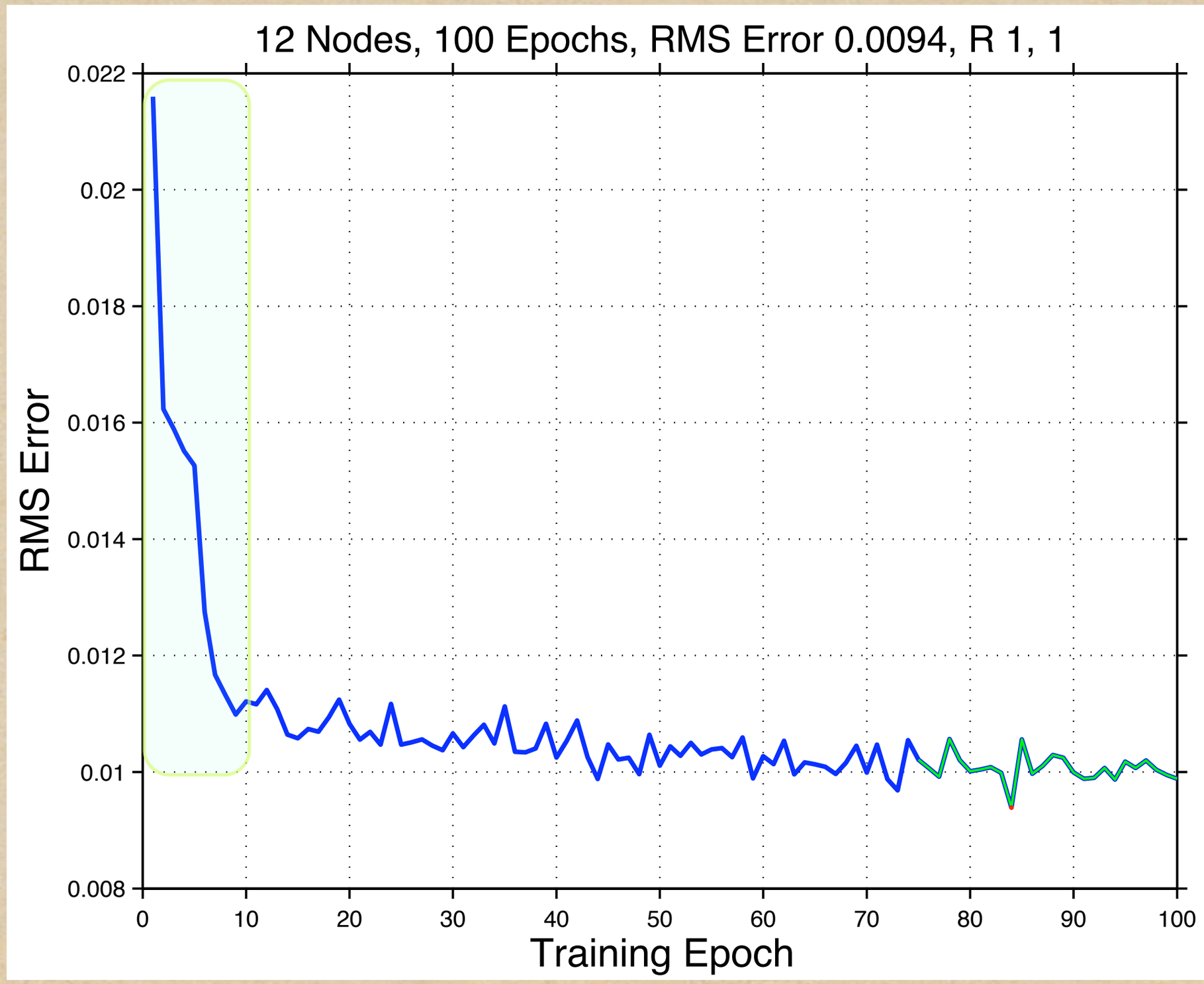


N2O


12 Nodes, 100 Epochs, RMS Error 0.0094, R 1, Output 1
x 10^-7
3.5
3
2.5
2
1.5
1
0.5
0
Data
NN
Tracer correlation
Output
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Input
x 10^-6

CH4


12 Nodes, 100 Epochs, RMS Error 0.0094, R 1, Output 1
x 10^-7
3.5
3
2.5
2
1.5
1
0.5
0
NN Estimate
0
0.5
1
1.5
2
2.5
3
3.5
Actual Value
x 10^-7


12 Nodes, 100 Epochs, RMS Error 0.0094, R 1, 1
RMS Error
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0
10
20
30
40
50
60
70
80
90
100
Training Epoch

Summary

- Hope the good progress continues!
- Interested in collaboration for other applications
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